ABSTRACT

The present invention is method of determining the distribution of shales, sands and water in a reservoir including laminated shaly sands using vertical and horizontal conductivities derived from nuclear, NMR, and multi-component induction data such as from a Transverse Induction Logging Tool (TILT). Making assumptions about the anisotropic properties of the laminated shale component and an assumption that the sand is isotropic, the TILT data are inverted. An estimate of the laminated shale volume from this inversion is compared with an estimate of laminated shale volume from nuclear logs using a Thomas-Stieber and Waxman-Smits model. A difference between the two estimates is an indication that the sands may be anisotropic. A check is made to see if a bulk water volume determined from the inversion is greater than a bulk irreducible water volume from NMR measurements. In one embodiment of the invention, NMR data are then used to obtain sand distribution in the reservoir. This sand distribution is used in a second inversion of the TILT data, assuming that the sand comprises a number of intrinsically isotropic layers, to give a model that comprises laminated sands including water and dispersed clay, laminated shales and clay-bound water. In another embodiment of the invention, a bulk permeability measurement is used as a constraint in inverting the properties of the anisotropic sand component of the reservoir. From the resistivities of the sand laminae, empirical relations are used to predict anisotropic reservoir properties of the reservoir.